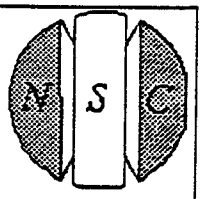


# Recommendations
## On The Use Of The
# Seven Member Confederation Of Models



National Simulation Center
June 24, 1994



The National Simulation Center
CONQUERING FRONTIERS

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**13. ABSTRACT** *(Maximum 200 words)*

The 1994 Confederation of Models is a set of DOD training simulations from each branch of the service which utilize the Aggregate Level Simulation Protocol (ALSP) to interact. The Confederation Verification , Validation, and Accreditation Master Plan (CVVAMP) consists of a several test plans and reports which include the: (a) Confederation of Models Verification , Validation, and Accreditation Master Plan (b) Technical Test Plan (c) Integrated Test Plan (d) Load Test Plan (e) Verification Test Plan.

Related reports include the: (a) Accreditation Report for the Confederation of Models in General Headquarters 94 (b) Recommendations on the Use of the Seven Member Confederation of Models.

The Accreditation Report for the use of the Confederation of Models in General Headquarters 94 (Phase III). This report explains the purpose of the document, background of the ALSP Confederation of Models, capabilities, and key issues and findings of the testing.



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# 1. INTRODUCTION

General Headquarters Exercise (GHQ) 94 was the most ambitious exercise ever undertaken from a technical point of view. For the first time a Command Post Exercise (CPX) was supported by five different simulations linked together in a Confederation of Models (COM) using the Aggregate Level Simulation Protocol (ALSP). Two members of the COM did not support GHQ 94 through ALSP. The Tactical Simulation (TACSIM) used its traditional point-to-point interface with CBS and the Marine Tactical Warfare Simulation (MTWS) did not participate.

This report itself is a result of the most ambitious attempt at verification, validation, and accreditation of the COM ever undertaken. For the first time a detailed systematic approach was used on the VV&A process, beginning with the first draft of the Confederation Verification, Validation and Accreditation Master Plan (CVVAMP) published in November 1993 and culminating in Confederation Test 94 at the Warrior Preparation Center in March 1994 and the GHQ 94 Confederation Test which used the CVVAMP to test the functional capabilities of the COM.

This accreditation report will present the capabilities and limitations of the COM as it was used in GHQ 94. It will also present the results of the confederation tests. These tests were performed in order to gather data on the technical, functional. and performance characteristics of the COM. Key issues are identified, along with possible ramifications and workarounds, in order to make informed recommendations regarding accreditation.

## 2. GENERAL

### 2.1 Confederation Models in GHQ 94

There were five simulations, or actors, which made up the Confederation of Models supporting GHQ 94. These actors were:

- Warrior Preparation Center Air Warfare Simulation (AWSIM 1.4.2);
- Corps Battle Simulation (CBS 1.5);
- Combat Service Support Training System Simulation (CSSTSS 1.5);
- Research, Evaluation, and Systems Analysis simulator (RESA 5.9.1);
- Joint Electronic Combat - Electronic Warfare Simulation (JECEWSI 1.6).

The version of the ALSP System Software being used was 7.1.

### 2.2 Confederation Functional Interfaces

The COM is based on functional interfaces. The interfaces describe the types of interactions between models. The six functional interfaces used by the models supporting GHQ 94 were:

- Air-To-Ground;
- Air-To-Air;
- Maritime;
- Tactical Ballistic Missile (TBM) / Cruise Missiles; and
- Sustainment.
- JECEWSI Ground Unit Initialization.

The proper operation of the functional interfaces are documented in the Interface Control Documents (ICDs) written by the developing organizations[1]. JECEWSI has special data requirements that are documented in its own individual ICD.[2] The 1994 ALSP

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[1]CBS/AWSIM Interface Control Document, Jet Propulsion Laboratory, Pasadena, CA, June 1993.
Aggregate Level Simulation Protocol (ALSP) Air-to-Air Engagement Interface Control Document (ICD), Sonalysts, Inc., San Diego, CA, February 1993.
Maritime Aggregate Level Simulation Protocol (ALSP) Interface Control Document (ICD), Sonalysts, Inc., San Diego, CA, September 1993.
Aggregate Level Simulation Protocol (ALSP) Theater Ballistic Missile / Cruise Missile Interface Control Document (ICD), Sonalysts, Inc., San Diego, CA, November 1993.

[2]Joint Electronic Combat - Electronic Warfare Simulation (JECEWSI) Interface Control Document (ICD) for Ground Unit Initialization, CACI Products Company, San

Confederation Operational Specification[3] summarizes and updates these ICDs for the 1994 Confederation. Short descriptions of each interface are provided below.

### 2.2.1 Air-To-Ground Interface

The air-ground interface was originally developed and implemented for the 1992 Confederation. The interface includes both ground-to-air interactions between ground-based air defense units and fixed wing aircraft missions, and air-to-ground interactions from fixed wing air missions against ground units and fixed targets. The interface also includes intra-theater airlift of equipment and units using Air Force fixed-wing air assets. In 1994, the air-ground interface definition was expanded to include interactions between fixed wing air missions and air bases. Miscellaneous improvements to the air-ground interface were also defined for 1994.

### 2.2.2 Air-To-Air Interface

The air-to-air interface was originally developed and implemented for the 1993 Confederation. The air-to-air interface supports air-to-air interactions between any combination of fixed-wing and rotary wing aircraft. No changes were made to the air-to-air interface for 1994.

### 2.2.3 Maritime Interface

The maritime interface was developed and implemented for the 1994 Confederation. The maritime interface allows for ship-to-air and air-to-ship interactions. It also provides naval gunfire support with ship-to-ground interactions.

### 2.2.4 TBM / Cruise Missile Interface

An interim TLAM functional interface was developed and implemented for the 1993 Confederation to allow TLAM engagements of ground targets and HIMAD engagements of TLAM. This interface was superseded in 1994 with the development of a complete TBM / Cruise Missile ICD. The TBM / Cruise Missile interface supports air-to-ground and air-to-ship interactions by TBM or cruise missiles against ground or sea-based targets, and ground-to-air and ship-to-air interactions from ground- and sea-based air defense assets against TBM and cruise missiles.

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Antonio, TX., December 1993.

[3] *Aggregate Level Simulation Protocol - 1994 Confederation Operational Specification (DRAFT)*, The MITRE Corporation, McLean, VA., February 1994.

### 2.2.5 Sustainment Interface

The sustainment interface was designed for 1994 and is documented in the developer ICD[4]. The sustainment interface is intended to provide detailed logistics activity for Army units in the areas of medical, maintenance, ammunition, POL and general resupply, equipment airlift, convoys, and Forward Reception and Onward Movement (F.R.O.M.).

CSSTSS and CBS are the primary participants in the sustainment interface. Other actors participate indirectly through their interfaces with CBS. For example, when the sustainment interface is invoked, resupply of HIMAD air defense missiles is provided to AWSIM by CSSTSS via CBS.

### 2.2.6 JECEWSI Ground Unit Initialization Interface

JECEWSI has its own individual interface, which it uses to collect information on the Ground Order of Battle (GOB), as well as the location of air defense units and radars in CBS. In its present state of development, however, JECEWSI still interacts with AWSIM through a point-to-point interface.

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[4] *CBS/CSSTSS Interface Control Document*, Jet Propulsion Laboratory, Pasadena, CA., December 1993.

## 2.3 Actor Participation

Table 2.1 depicts actor participation in each of the functional interfaces. The following sections describe in detail individual actor participation in the 1994 Confederation.

| INTERFACE | ACTOR | | | | |
|---|---|---|---|---|---|
| | AWSIM | CBS | CSSTSS | RESA | JECEWSI |
| Air-To-Ground | X | X | X | X | |
| Air-To-Air | X | | | X | |
| Maritime | X | X | X | X | |
| TBM/CM | X | X | X | X | |
| Sustainment | | X | X | | |
| JECEWSI (Listen only) | | | | | X |

**Table 2.1**
**Actor Participation in Functional Interfaces**

### 2.3.1 AWSIM

AWSIM was a member of the 1993 Confederation, participating in the air-ground, air-air and interim TLAM interfaces as a time-constrained and time-regulating actor. New functional interfaces added to AWSIM for the 1994 Confederation were

- new air-ground capabilities - AWSIM accepted air-to-ground interactions against air bases and air defense units and generated ground-to-air interactions;
- miscellaneous improvements to the existing air-ground interface;
- ship-air; and
- full TBM / cruise missile, including the capability to own, defend against, and accept attrition from both TBM and cruise missiles.

### 2.3.2 CBS

CBS was a member of the 1993 Confederation, participating in the air-ground and interim TLAM interfaces as a time-constrained and time-regulating actor. New functional interfaces added to CBS for the 1994 Confederation were

- miscellaneous improvements to the existing air-ground interface;
- ship-to-ground; and
- partial implementation of the TBM / cruise missile functional interface - CBS accepted TBM and cruise missile interactions from other actors.

In addition, CBS 1.5 featured a redesign of the CBS ALSP translator.

### 2.3.3 CSSTSS

CSSTSS is a new confederation participant. It is a time-constrained and time-regulating actor. Functionalities provided by this model are

- Forward Reception and Onward Movement (F.R.O.M.);
- Detailed logistics activity for Army units.

### 2.3.4 RESA

RESA was a member of the 1993 Confederation, participating in the air-air and interim TLAM interfaces as a time-constrained and time-regulating actor. New functional interfaces added to RESA for the 1994 Confederation were

- all air-ground, including the newly defined air base attack;
- ship-air;
- ship-to-ground; and
- full TBM / cruise missile, including the capability to own, defend against, and accept attrition from both TBM and cruise missiles.

### 2.3.5 JECEWSI

JECEWSI is a new member of the 1994 Confederation. The JECEWSI translator participated as a time-constrained and -regulating actor. Time in JECEWSI itself is controlled by AWSIM via the AWSIM - JECEWSI point-to-point interface. JECEWSI also listened to updates on ground objects to determine the command structure for air defense units and the operational status of air defense radars.

# 3. CAPABILITIES

Each functional interface brought into play by the inclusion of specific models in the COM added specific capabilities to the COM. It is these capabilities which allow the Confederation to support CPXs with far more fidelity and realism than any single model. The capabilities which the COM brought to GHQ 94 are listed below.

## 3.1 Air-To-ground Capabilities

The ALSP ATG Interface provided the COM with several capabilities. It allowed for a more realistic simulation of air power within CBS, and provided AWSIM and RESA with active ground forces, providing more robust training. Through this interface, ALSP ghosted air missions and aircraft of all types, allowed for engagement of both ground units and fixed targets, and accurately transferred CBS air defense play to AWSIM, RESA, and JECEWSI. SEAD, Electronic degradation of ADA radars, and F-117/B-2 stealth capabilities were portrayed.

## 3.2 Air-To-Air Capabilities

The ATA interface allowed for the detection, classification, and engagement of aircraft owned by different members of the COM. It covered both visual and electronic identification, electronic surveillance measures (ESM), and radar jamming. In addition, this interface provided a method for models to attack bases which existed in other members of the COM.

## 3.3 Maritime Capabilities

The Maritime Interface allowed for identification, classification, and engagements between ships owned by the Maritime model (RESA) and aircraft owned by the Air model (AWSIM). It also provided the potential for naval gunfire operations against ground units and fixed targets within CBS.

## 3.4 TBM/CM Capabilities

The TBM/CM Interface provided the COM with the capability of launching TBMs, such as SCUD missiles from one model, and targeting and causing attrition to objects in another model. It also allowed for the portrayal of both ground-, air-, and sea-launched cruise missiles from one model to another.

### 3.5 Sustainment Capabilities

The Sustainment Interface was significant in that, for the first time, an operationally-oriented model (CBS) was disciplined by a logistics-oriented model (CSSTSS). This interface allowed for items in the Played Items List (PIL) to be tracked in greater detail. It also provided for the movement of FROM units into the exercise theater. CSSTSS simulated all classes of supply and the handling of casualties from combat in CBS. Rotary-wing supply lift capability was also portrayed through this interface.

### 3.6 JECEWSI Ground Unit Initialization Capabilities

The JECEWSI Interface provides the COM with the potential to incorporate Command and Control Warfare (C2W) components of Electronic Warfare (EW) to all members of the COM. Prior to the inclusion of JECEWSI in the COM, this information was available to AWSIM only through an inflexible point - to - point interface. Information on CBS units necessary to JECEWSI is now provided through the ALSP. AWSIM interaction with JECEWSI continues via the point-to-point interface for 1994.

# 4. LIMITATIONS

Because of differences in basic simulation design, operational concept, or even software development priorities, there are limitations which each interface brings to the COM. The primary limitations of each interface are described below. Often these limitations have little or no effect on the conduct of an exercise; at other times workarounds are required in order to overcome a particular shortcoming.

## 4.1 Air-To-Ground Limitations

a. CBS rotary-wing aircraft are not ghosted in other members of the COM, nor are rotary-wing aircraft from other models ghosted within CBS.
b. Because blue-air-weapon-to-blue-system damage tables are all set to 0 in CBS, ATG fratricide is not played.
c. When CSSTSS is joined as a member of the confederation, units and supplies can not be airlifted by AWSIM or RESA aircraft.

## 4.2 Air-To-Air Limitations

a. CBS rotary-wing aircraft are not ghosted in other members of the COM, nor are rotary-wing aircraft from other models ghosted within CBS.
b. Aircraft from one model cannot be refueled from a tanker owned by another model, nor can they land at a base owned by another model.
c. When AWSIM aircraft are being affected by electronic degradation from JECEWSI, RESA aircraft can be more effective in ATA engagements. This limitation is being addressed by the ALSP Combat Interactions Subgroup, with the intention of extending JECEWSI's degradation effects to RESA for 1995.

## 4.3 Maritime Limitations

a. CBS ground units are presently unable to attack ships in RESA.
b. The implementation of the Amphibious Operations and Electronic Warfare sections of the Maritime interface are presently not implemented.
c. Naval gunfire in RESA is actually portrayed in CBS as an air-to-ground interaction, which is not a truly accurate representation of naval gunfire.
d. Because naval gunfire is portrayed in CBS as an air-to-ground interaction, and because blue-air-weapon-to-blue-system damage tables are all set to 0 in CBS, naval gunfire fratricide is not played.

## 4.4 TBM/CM Limitations

AWSIM and RESA are presently unable to successfully engage TBMs launched from the other model. This is due to the time envelope involved. WPC and NRaD are working on

a resolution to this and a solution is expected to be ready for Confederation 95.

### 4.5 Sustainment Limitations

a. Air assault and unit airlift are not available. Workarounds are required. This is scheduled to be included in CSSTSS for 1995.
b. Helicopters cannot deliver supplies to a maneuver unit. They can only deliver supplies between CSSTSS controlled units. A workaround is required.
c. When a CBS unit is wiped out, it cannot be 'magiced' back to life, as CSSTSS cannot resurrect icons.
d. All personnel and equipment entering organizational level treatment/repair facilities are instantly returned as ready. The CBS combat damage report would reflect all wounded personnel and all damaged equipment, while the logistics report will not capture information on those in organizational level facilities. Therefore, the two reports will probably not match.
e. OPFOR units can detect CSSTSS units, but the detection report will only reflect TOE items. Supplies available for issue such as stocks of fuel and ammunition will not be reflected in the report.
f. Caches may be used by CBS units to offload/draw consumable supplies only. There is no convoy interaction with caches.
g. Convoys will deliver supplies only between CSSTSS supply units. They will not interface in any way with supply collections. CBS does not have visibility over supplies on a convoy. Convoys will travel only on standard routes.
h. "Show Incoming Supplies" will not reflect supplies being transported by a CSSTSS controlled convoy.
i. CBS - CSSTSS Mirrored Databases: The mirrored database design of the sustainment interface is extremely sensitive to software, hardware, or communications disruptions. Such disruptions can result in a lack of a consistent representation of the battlefield across the Confederation.
j. Splits and Merges: Because of the way in which unit splits and merges are tracked and processed in CSSTSS, there is currently a practical limit of approximately 50 splits and/or merges per hour. This is because CSSTSS presently tracks all splits and merges, including those at the tactical level, which is irrelevant to that model. The long-term fix which has been proposed is for CBS to track ground units' tactical formations and for CSSTSS to end its logistical responsibilities at the UIC level, i.e. at the Battalion or Company level.
k. CSSTSS End of Day Processing: Because GHQ 94 was 12-hour per day exercise CSSTSS was able to perform its end of day processing and printing during off hours every other day. These actions can typically take up to 4 hours to perform. This can not be accomplished during a normal 24-hour per day exercise.
l. Recovery: Should CSSTSS fail, or should CBS fail on an order involving a unit split or merge, the entire COM must be returned to the last checkpoint and all player activity subsequent to the checkpoint must be replayed. As a result, recovery time would range from 20 to 80 minutes, as compared with 20 minutes for other failures.

### 4.6 JECEWSI Limitations

JECEWSI electronic degradation effects do not currently extend to RESA aircraft as they do to AWSIM aircraft. This can result in better air-to-air engagement results for RESA aircraft.

# 5. CONFEDERATION TESTING

The 1994 ALSP Confederation of Models (COM) underwent verification testing from 14 through 25 March, 1994 at the Warrior Preparation Center in Einsiedlerhof, Germany. Three separate testing stages were performed; technical testing, functional testing, and load testing. Additional testing was performed from 2 through 13 May, 1994 at the National Simulation Center, Fort Leavenworth, KS.

## 5.1 1994 Confederation Test

The 1994 Confederation Test was conducted on 14-25 March, 1994 and was hosted by the Warrior Preparation Center (WPC). U.S. Army Simulation, Training and Instrumentation Command (STRICOM) served as the Test Director, U.S. Army National Simulation Center (NSC) as the Functional Test Director, and the ALSP Systems Engineer served as Technical Test Director. The technical test plan used was the ALSP Confederation Management Technical Test Plan written by Mitre Corporation. Functional testing was performed using the Confederation VV&A Master Plan (CVVAMP), Part III, Confederation '94 Integrated Test Plan, which was compiled by the Joint & Combined Division of the National Simulation Center, Models & Simulations Directorate. Load testing was based on the Confederation Load Test Plan, written by the Mitre Corporation. The load test plan included three phases: CBS Rank Order of Effects (ROE); Typical Expected Load (TEL); Maximum Expected Load (MEL). The results of this testing were documented in the 1994 Aggregate Level Simulation Protocol (ALSP) Confederation Test Accreditation Report, compiled by Mitre Corporation.

### 5.1.1 Test Objectives

The primary objectives of the Confederation Test were to:

a. Verify that the participating actors meet the technical requirements for operating in an ALSP Confederation and that the ALSP Systems Software supports Confederation operations;
b. Verify and, to the extent possible, validate the functional interfaces between the participating actors; and
c. Demonstrate that the Confederation can operate at a 1:1 game ratio under the loads anticipated for the major target Confederation exercises for 1994 - Prairie Warrior 94, Ulchi Focus Lens 94, and REFORGER 94.

These objectives were met through the conduct of three distinct phases of the Confederation Test: the Technical Test, the Functional Test, and the Load Test.

A secondary objective of the test was to provide a measure of the risk associated with augmenting the Confederation with a sustainment interface. The ALSP Review Panel had approved a sustainment interface for inclusion in the 1994 Confederation development

process. Because of problems associated with the requirement for mirrored databases in CSSTSS and CBS, CSSTSS was not ready in time to participate in the full Confederation Test. However, because there is a requirement for some exercises to use the sustainment interface regardless of its participation in the Confederation Test the test participants agreed to conduct as much testing as was feasible of the sustainment interface. This testing was designated as the Sustainment Interface Test (SIT) and was conducted during the last two days of the Confederation Test.

### 5.1.2 Technical Testing

The Technical Test was conducted from 08:00 March 15 through 12:15 March 16. The Technical Test was directed by the Technical Test Director according to the ALSP Confederation Management Technical Test Plan[5]. The test was designed to verify that actors in the Confederation demonstrate sufficient technical interoperability to support an exercise. The test also verifies the ALSP System Software.

#### 5.1.2.1 Technical Test Areas

The Technical Test covered the following topics:

- joining and resigning from the Confederation;
- filter verification;
- object initialization;
- object refresh;
- time synchronization;
- ghosting of objects;
- confederation save and restore; and
- crash recovery.

#### 5.1.2.2 Technical Test Results

The members of the 1994 Confederation successfully completed the Confederation Management Technical Test Plan, with only one outstanding issue at the end of the Confederation Test. The remaining issue, and course of action to redress the issue, are described below. Because TACSIM will be using a standard point-to-point interface at GHQ 94, this issue is of no immediate consequence.

> **Issue:** TAT Operator Control. The TAT listens to updates on reconnaissance missions flown by other actors. The name of the mission must be manually input at the TAT for it to be recognized. Operator input is only allowed at the TAT when simulation time is not advancing. The current TAT design is to stop

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[5] *ALSP Confederation Management Technical Test Plan,* The MITRE Corporation, McLean, VA, January 1994.

periodically to allow operator input. The entire Confederation will stop until the TAT operator allows time to continue to advance.
**Solution:** Change TAT operator interface to allow simulation time to continue to advance.
**Test Plan:** Retest TAT operator interface with Systems Engineer prior to first use at UFL 94.

Confederation saves and restores were timed to ensure that they were within acceptable limits. During load testing, Confederation save times were 5.5-6 minutes.[6] and restore times were on the order of 10 minutes. After the Confederation restores from a save, the CBS workstations must also be refreshed: this operation adds approximately 10 minutes for a total time of twenty minutes for the restoration process.

### 5.1.3 Functional Testing

The Functional Test was conducted from 13:00 March 17 through 12:15 March 20. The Functional Test was directed by the Functional Test Director according to the Confederation Verification, Validation, and Accreditation Master Plan (CVVAMP)[7]. The test was designed to verify and, to the extent possible, validate, the functional interfaces between the actors in the Confederation.

#### 5.1.3.1 Functional Test Areas

The categories of functional testing include:

- Air-Ground;
- Air-Air;
- Maritime (including Ship-Air and Ship-to-Ground);
- TBM / Cruise Missile; and
- JECEWSI - specific functional tests.

#### 5.1.3.2 Functional Test Results

Overall, the verification testing of the Confederation of Models was very successful. Five ALSP interfaces were tested in full, using the four following models: AWSIM, CBS, JECEWSI, and RESA. In addition, MTWS and TACSIM were tested in a more limited, listen-only mode. A total of 113 separate tests were used to verify the proper

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[6]Confederation save times increase as actor loads and ALSP object counts increase.

[7]*Confederation Verification, Validation, and Accreditation Master Plan (CVVAMP), Part III, Confederation '94 Integrated Test Plan*, U. S. Army National Simulation Center, Ft. Leavenworth, KS, March 1994. (Part III of the CVVAMP is the integrated product of all developer test plans for the functional interfaces).

functionality of these interfaces. Of these tests, a total of 106 were completed successfully, and 7 were completed with limited success. There were no tests which were determined to be completely unsuccessful. A more detailed description of the capabilities and limitations of Confederation is presented below.

Table 5.1 summarizes the status of functional testing at the end of the Confederation Test[8]. All 113 tests[9] were completed - 106 were totally successful, 7 were completed with limited success, and none were unsuccessful.

| Test Plan | Status | | | | |
|---|---|---|---|---|---|
| | Success | Limited Success | Unsuccessful | Total Complete | Total Tests |
| Air-to-Ground | 71 | 5 | 0 | 76 | 76 |
| Air-to-Air | 10 | 0 | 0 | 10 | 10 |
| Maritime | 6 | 0 | 0 | 6 | 6 |
| TBM / CM | 2 | 2 | 0 | 4 | 4 |
| JECEWSI | 17 | 0 | 0 | 17 | 17 |
| TOTAL | 106 | 7 | 0 | 113 | 113 |

**Table 5.1**
**Functional Test Status**

Table 5.2, the Functional Test Coordination Matrix, describes the seven tests that were met with limited success and the actions that are planned to redress outstanding issues. The eighth entry in the Functional Test Coordination Matrix refers to air-to-air testing, which was all successfully completed, but raised questions about the realism and validity of the results of the engagements.

[8]These results include fifteen tests that were retested during the SIT.

[9]There are 120 tests in these five sections of the CVVAMP, but 7 of them were not applicable to the Confederation.

| Test Plan | Test | Comment / Issue | Action |
|---|---|---|---|
| Air-Ground | 2.5-9 Electronic Degradation of ALLRAD | Unable to fully test. Confidence is high due to results of HIMAD test. | No action |
| Air-Ground | 2.6-8 Shock Suppression of Radars by AWSIM Air | AWSIM unable to pass target priority. | WPC to fix prior to GHQ |
| Air-Ground | 2.7-4 CBS SHORAD vs. AWSIM aircraft | Some SHORAD types do not appear to be shooting. | JPL to fix prior to GHQ |
| Air-Ground | 2.9-1 Air-to-Ground of a Specific Location | PK table partially fixed | WPC and CECOM to fix prior to GHQ |
| Air-Ground | 2.9-2 Air-to-Ground Attack on Fixed Targets | Unable to damage engineer bridge, Road Interdiction Points. | JPL to fix prior to GHQ |
| TBM / CM | 5.2-2 TBM / CM Operation | Interface works, but TBMs out of envelope for successful engagement | WPC / NRaD to address for 1995 Confederation |
| TBM/CM | 5.2-3 ALCM Operation | Little or no damage to certain targets with certain missiles. CBS PK problem | JPL / CECOM to fix prior to GHQ |
| Air-to-Air | 3.2.8 Air-to-Air Engagements | RESA aircraft appear to be more effective than AWSIM aircraft. Possibly JECEWSI effects. | Combat Interactions Subgroup to investigate for 1995 Confederation |

**Table 5.2**
**Functional Test Coordination Matrix**

5.1.4 Load Testing

The Load Test was conducted between 14:30 March 20 and 12:15 March 23. The Load Test was directed by the Technical Test Director according to the Confederation Load test Plan[10]. The test was designed to demonstrate that the Confederation can operate at a 1:1 game ratio under the loads anticipated for the target Confederation exercises for 1994 - Prairie Warrior 94, Ulchi Focus Lens 94, and REFORGER 94.

5.1.4.1 Load Test Areas

The Load Test was conducted in three phases:

- CBS Rank Order of Effects (ROE);
- Typical Expected Load (TEL); and
- Maximum Expected Load (MEL).

[10] *Confederation Load Test Plan,* The MITRE Corporation, McLean, VA, March 1994.

Exercise scenario parameters that drive individual actor performance for CBS, AWSIM, and RESA[11] were identified by the model developers. These parameters are summarized in Table 5.3.

| Actor | Load Parameters |
|---|---|
| CBS | Units, ADA units on weapons free status, ghosted fixed wing air missions, artillery missions, helicopter missions, convoys, infiltrations, combat sets |
| AWSIM | Fixed wing and rotary wing air missions, HIMAD and ALLRAD[12] units |
| RESA | Ships, boats, fixed wing and rotary wing air missions, cruise missiles, TBMs, air bases, submarines, torpedoes, active radars, sonobuoy fields, total RESA units, ALSP ghosted units, total units in the database. |

**Table 5.3**
**Actor Load Parameters**

During each phase of the load test, activity was generated in each of the actors in the Confederation to drive the values of the load parameters to the target levels for that phase. Once the desired load was reached, the actual values of the load parameters, the game ratio attainable at that load, and technical performance characteristics of the Confederation[13] were measured.

The ROE phase of the load test was conducted to determine the relative impact of load parameters on the performance of CBS, the actor that was the limiting factor in the 1993 Load Test.

The most significant phase of the load test was the TEL. Model developers and the user community responsible for exercise support for the 1994 exercises provided values for the load parameters that represented the typical *surge* of activity that would be expected to be placed on the Confederation in an exercise. For example, the community estimated that the typical number of Air Force fixed wing air missions that would be flown in a surge in AWSIM was 300 and that the typical peak number of ground units that would be represented in CBS was 7,000. These load parameter values were then generated in the

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[11]No parameters were needed for JECEWSI and TAT because only the translators affect Confederation performance. MTWS was not loaded.

[12]"ALLRAD" is the term used in the Confederation to designate those air defense units for which fire control can be transferred between actors.

[13]Technical performance data collected included the ALSP Common Module statistics file, the ALSP Broadcast Emulator statistics file, VAX systems utility data, Image Monitor Utility data for CBS, AWSIM and JECEWSI, CBS unit cross-reference files, RESA and MTWS game statistics, and LANLYZER and EMON network data.

actors simultaneously and were sustained while data was collected.

The MEL phase of the exercise was conducted as an experiment to examine the behavior of the Confederation as the load was increased beyond the TEL, and, assuming that the Confederation could achieve a 1:1 game ratio at TEL, to determine the point at which the Confederation could no longer achieve that ratio.

The Load Test was conducted with all actors hosted on hardware platforms similar to those expected to be used in exercises. Table 5.4 describes the configuration used for the Load Test.

| VAX Type | CPUs | Memory (Mb) | Main Processes |
|---|---|---|---|
| 6620 | 2 | 320 | AWSIM Wargame<br>AWSIM ACM<br>TAT ACM<br>GMI |
| 6440 | 4 | 256 | RESA Wargame<br>RESA ACM<br>RESA Message Generator |
| 6340 | 4 | 160 | JECEWSI<br>JECEWSI ACM |
| 6340 | 4 | 256 | TMS<br>C2 |
| 6620 | 2 | 512 | CBS Wargame<br>CBS ACM<br>ABE |
| 3900 | 1 | 48 | MTWS ACM |
| VS3110 | 1 | 32 | TAT |

**Table 5.4**
**Hardware Configuration of Load Test Processes**

5.1.4.2 Load Test Results

5.1.4.2.1 ROE Results

The results of the ROE are intended to provide exercise directors with information useful for reducing loads in CBS, should its performance degenerate in a Confederation exercise. The results of ROE are not directly pertinent to Confederation accreditation, particularly given the successful results of the TEL, and therefore are not included in this report, but are included in the 1994 Confederation Load Test Report published by Mitre Corporation.

5.1.4.2.2 TEL Results

The Confederation was able to maintain, and exceed, a 1:1 game ratio during the TEL phase of the exercise. The TEL load parameter and game ratio target and actual values are summarized in Table 5.5. Most of the TEL load parameter target values were met or exceeded. Confederation performance did *not* preclude reaching the targets during this phase of the Confederation Test. Generating specific loads concurrently across the Confederation is very difficult, and these actual parameter values represent the test participants' best efforts to generate the precise load specified for the TEL.

| Parameter | TEL Target | TEL Actual | % of Target |
|---|---|---|---|
| **CBS Parameters** | | | |
| Total Units | 7,000 | 8,145 | 116 |
| Weapons Free ADA Units | 300 | 2,136 | 712 |
| Ghosted Air Missions | 300 | 205 | 68 |
| Artillery Missions | 200 | 200 | 100 |
| Helicopter Missions | 60 | 61 | 102 |
| Convoys | 50 | 45 | 90 |
| Infiltrations | 250 | 250 | 100 |
| Combat Sets | 50 | 98 | 196 |
| **AWSIM Parameters** | | | |
| Air Missions | 300 | 336 | 112 |
| HIMAD / ALLRAD Units | 90 | 292 | 324 |
| **RESA Parameters** | | | |
| Ships | 325 | 325 | 100 |
| Boats | 150 | 150 | 100 |
| Air Missions | 100 | 100 | 100 |
| Cruise Missiles / TBM | 30 | 0 | 0 |
| Air Bases | 50 | 33 | 66 |
| Helicopter Missions | 10 | 6 | 60 |
| Submarines | 100 | 114 | 114 |
| Torpedoes | 10 | 10 | 100 |
| Active Radars | 400 | 260 | 65 |
| Sonobuoy Fields | 10 | 8 | 80 |
| Total RESA Units | 700 | 737 | 105 |
| ALSP Ghosted Units | 300 | 407 | 135 |
| Total Units in Database | 1,000 | 1144 | 114 |
| **Confederation Game Ratio** | | | |
| Game Ratio (range) | 1.00 | .97-1.44 | N/A |
| Game Ratio (average) | 1.00 | 1.20 | N/A |

**Table 5.3**
**TEL Load Parameter Targets and Actuals**

5.1.4.2.3 MEL Results

At the first *measured* point of the MEL at which the Confederation could no longer achieve a 1:1 game ratio, the load parameter values equaled or exceeded the TEL target load parameters[14]. MEL statistics at this point are summarized and compared to TEL data in Table 5.6. It should be noted that, because loads are built up incrementally, the first point at which the Confederation was unable to maintain a 1:1 game ratio was somewhere between TEL and this point.

| Parameter | Actual | % TEL Target | % TEL Actual |
|---|---|---|---|
| **CBS Parameters** | | | |
| Total Units | 8402 | 120 | 103 |
| Weapons Free ADA Units | 2188 | 729 | 102 |
| Ghosted Air Missions | 371 | 124 | 181 |
| Artillery Missions | 400 | 200 | 200 |
| Helicopter Missions | 78 | 130 | 128 |
| Convoys | 106 | 212 | 236 |
| Infiltrations | 471 | 188 | 188 |
| Combat Sets | 100 | 200 | 102 |
| **AWSIM Parameters** | | | |
| Air Missions | 373 | 124 | 104 |
| HIMAD / ALLRAD Units | 292 | 324 | 100 |
| **RESA Parameters** | | | |
| Ships | 325 | 100 | 100 |
| Boats | 198 | 132 | 132 |
| Air Missions | 113 | 113 | 114 |
| Cruise Missiles / TBM | 40 | 133 | None in TEL |
| Air Bases | 33 | 66 | 100 |
| Helicopter Missions | 13 | 130 | 217 |
| Submarines | 114 | 114 | 100 |
| Torpedoes | 10 | 100 | 100 |
| Active Radars | 480 | 120 | 185 |
| Sonobuoy Fields | 20 | 200 | 250 |
| Total RESA Units | 846 | 121 | 115 |
| ALSP Ghosted Units | 415 | 138 | 102 |
| Total Units in Database | 1261 | 126 | 110 |
| **Confederation Game Ratio** | | | |
| Game Ratio (range) | .66-1.35 | N/A | N/A |
| Game Ratio (average) | .83 | N/A | N/A |

**Table 5.4**
**MEL Load Parameter Values and Comparison to TEL**

Preliminary analysis of the technical performance data collected indicates that when it was

[14]The exception was RESA airbases - which is not considered a critical load parameter.

not maintaining adequate speed, the Confederation was primarily waiting for RESA[15] and occasionally for CBS.

The load parameters driving the performance of these actors at the MEL data point were the number of active radars in RESA and the number of ghosted air missions in CBS. In the MEL phase, there was a maximum of 480 active radars in RESA. This is 120% of the TEL target and 185% of the actual TEL value. For CBS in the MEL phase, there was a maximum of 371 ghosted air missions. This is 124% of the TEL target and 181% of the actual TEL value.

These two driving load parameters were among those that did not reach TEL targets while the Confederation was operating at 1:1 during the TEL phase of the Load Test. Therefore, it cannot be definitively concluded whether the Confederation could or could not support the TEL targets for these parameters.

In 1993, however, CBS was able to ghost 340 air missions while the Confederation was running at 1:1, indicating that the TEL target of 300 missions may have been achievable, even if the MEL value of 371, *combined with all other MEL activity*, was not.

The number of active radars in RESA was not recorded in 1993, so a similar comparison is not possible.

The fact that TEL targets were reached or exceeded for all other parameters during the MEL and that these parameters were not performance drivers at that point, indicates that the TEL targets for these parameters are all achievable.

The behavior of the Confederation at these extreme loads will be further analyzed in the Load Test Report.

### 5.1.5 Sustainment Interface Testing

The Sustainment Interface Test (SIT) was conducted between 1330 March 23 and 1200 March 25. The Sustainment Interface Test (SIT) was designed to test, to the extent possible in the time remaining at the Confederation Test, the Confederation augmented by the Combat Service Support Training Simulation System (CSSTSS 1.4) and a sustainment interface.

The sustainment interface was designed for 1994 and is documented in the developer

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[15]It should be noted that, of the VAX-hosted actors, RESA was running on the smallest machine. Preliminary analysis of the data suggests that better Confederation performance could be achieved by switching platforms for RESA and AWSIM.

ICD[16]. The sustainment interface is intended to provide detailed logistics activity for Army units in the areas of medical, maintenance, ammunition, POL and general resupply, equipment airlift, convoys, and Forward Reception and Onward Movement (F.R.O.M.).

CSSTSS and CBS are the primary participants in the sustainment interface. Other actors participate indirectly through their interfaces with CBS. For example, when the sustainment interface is invoked, resupply of HIMAD air defense missiles is provided to AWSIM by CSSTSS via CBS.

CSSTSS participated in the augmented Confederation as a time-constrained and time-regulating actor.

5.1.5.1 Test Areas

The SIT included technical testing, directed by the Technical Test Director according to the ALSP Confederation Management Technical Test Plan, and functional testing, directed by the Functional Test Director according to the CVVAMP. No load testing was conducted.

5.1.5.1.1 Technical Testing

There were three technical areas of special interest for the sustainment interface. The first area was the initialization of CSSTSS and CBS. These actors do not dynamically "ghost" each other's units, instead they rely on duplication (mirroring) of all units in both game databases. The initialization process between the two actors verifies that both actors recognize the same units and that all units are recognized as ALSP objects. An objective for the technical test was to ensure that this initialization process was working correctly, and to record timing data for the process.

The second area involved testing recovery of the augmented Confederation after messages are lost. This test was necessary because the sustainment interface design is different from the other interfaces in that absolute attribute values are not exchanged between actors. Instead, the actors exchange information about changes in attribute values. For example, a message providing the absolute value for the number of tanks owned by a unit would indicate that the unit owns ten tanks, while a message describing a change would indicate that the unit lost two tanks. As a result, if a message describing a change is lost, that information is unrecoverable. If a message providing absolute values were lost, the error would persist only until the next message was generated.

Because CSSTSS, which operates on an IBM platform, is necessarily operated over a

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[16] *CBS/CSSTSS Interface Control Document*, Jet Propulsion Laboratory, Pasadena, CA., December 1993.

wide area network at a site separate from the rest of the Confederation , there is special concern for lost messages. In addition to the communications links themselves, there are many processes between the CSSTSS ACM and the CSSTSS game (CSSTSS translator, SNA-DECNET protocol converters, IBM front processors, etc.) each of which could crash or reinitialize and thus lose a message.

The third special technical test for the SIT was testing of the CBS - CSSTSS "de-link" capability. This capability allows CSSTSS to be irrevocably removed from the Confederation in the event of total communications loss or other failure, while allowing CBS to continue to participate. After de-link, CBS provides its own logistics play.

5.1.5.1.2 Functional Testing

Functional testing included the Sustainment section of the CVVAMP, retesting of 15 tests from the Functional Test after software modifications, and "freeplay" of other combat interactions. Because time constraints did not permit execution of the Air-Ground, Air-Air, Maritime, TBM/CM and JECEWSI portions of the CVVAMP, freeplay was conducted to create a wide range of activity in the augmented Confederation and exercise the simulations in those areas that could not be tested.

5.1.5.2 Test Results

5.1.5.2.1 Technical Test Results

The augmented Confederation successfully completed the basic technical tests. Confederation saves times were the same with two distinctions. First, the initial CSSTSS game save takes longer than subsequent saves - about 15 minutes. Secondly, CSSTSS saves are designed such that the Confederation waits only for the CSSTSS translator to save - the CSSTSS translator allows Confederation time to advance while the CSSTSS game completes its save. During this period the CSSTSS translator queues up any incoming ALSP messages. When the CSSTSS game save is complete, the game processes the queued messages and catches back up to Confederation time. The CSSTSS translator saves its state quickly and therefore has little impact on the amount of time the Confederation must stop for a save. The best time recorded for the CSSTSS game save was 7.5 minutes. This time will vary with Confederation activity.

Confederation restores operate differently when the Confederation is augmented by the sustainment interface. Normally, if an actor crashes, only that actor must take action while the remainder of the Confederation remains suspended in time. Exercise time lost from individual actor recovery times ranges from negligible to 20 minutes.

However, in an augmented Confederation, if CBS or CSSTSS crash, the entire Confederation must go back to the last Confederation-wide save. This is a result of the CBS-CSSTSS mirrored databases. Normally, CBS alone would restore from a save and,

running as fast as possible, automatically replay all orders from the time of the save to catch back up to the Confederation. But in an augmented Confederation, CSSTSS and CBS would have to be able to replay activity from the save in a coordinated way that ensures that the end state in both game databases is consistent. There is no mechanism to do this, so the entire augmented Confederation must restore from the last Confederation-wide save, and the activity that was generated from the time of the save to the time of the crash must be re-played.

Exercise time lost would be the sum of the following times: time to restore the Confederation from the last save (approximately 10 minutes); time to refresh CBS workstations (approximately 10 minutes); and time to replay activity from the save back to the point of the disruption. To minimize recovery times using this mechanism, frequent saves would be advisable. Hourly saves would result in restoration times ranging from 20 minutes (if the disruption occurred immediately following a save) to 1 hours and 20 minutes (if the disruption occurred just before the next save were taken).

The initialization process for CSSTSS and CBS was successfully tested and was timed at one hour and 35 minutes.

Communications failures were a frequent occurrence during testing - the link between WPC and Rock Island Arsenal, Illinois, where CSSTSS was running, was disrupted from 1 to 5 times and an average of 2 times per day. Because of concerns about the reliability of the link, the CSSTSS ACM was operated at the WPC, and the CSSTSS translator was operated at Rock Island. This configuration was selected to allow the ACM to buffer messages should a communications disruption occur. However, during the course of the SIT, many messages were evidently lost, resulting in significant misalignment of the CBS and CSSTSS databases. It is not understood how these messages were lost or which software processes may be involved, although, as noted earlier, there are many processes between the CSSTSS ACM and the CSSTSS game that could have been involved.

Two recovery mechanisms are available should messages be lost. The first method is a global update of combat and combat service support units. This method restores the units to whatever state is maintained by CSSTSS. During the SIT, a variation of global update was tested that only updated the units that CSSTSS indicated had been changed over the course of testing. This variation was timed at approximately 40 minutes. However, this mechanism is not recommended because it does not account for those units that were changed by CBS, but were not known to have changed by CSSTSS because the messages were lost. An alternative, not explicitly tested at the SIT, is to update all units. It is estimated that a complete update would take as long as the initialization process: one hour and 35 minutes.

The second recovery method is to restore the entire augmented Confederation from a Confederation-wide save. As described earlier, this operation would take from twenty minutes to one hour and twenty minutes.

The de-link between CBS and CSSTSS was successfully tested.

5.1.5.2.2 Functional Test Results

All 17[17] tests in the Sustainment portion of the CVVAMP were completed - 10 were totally successful, 6 were completed with limited success, and one was unsuccessful.

Table 5.7, the Functional Test Coordination Matrix, describes the seven tests that were met with limited success or were unsuccessful and the actions that are planned to redress outstanding issues. In addition, fixed wing airlift is understood to be a capability that is not provided when the sustainment interface is in place and therefore was not tested.

The results of the 15 retests are included in 5.1.3.2, Functional Test Results. The freeplay of other combat interactions was successful and caused no software failures.

| Test Plan | Test | Comment / Issue | Action |
|---|---|---|---|
| Sustainment | 6.2-3 Convoy truck attrition updates | Need to confirm CSSTSS reports of attrition | NSC to test prior to GHQ |
| Sustainment | 6.3-1 CSS unit movement in CBS | CBS reports final destination as 200m away from directed destination | JPL to fix prior to GHQ |
| Sustainment | 6.3-2 CSS unit move can't complete in CBS | Unit stopped at barrier. Report to CSSTSS did not give reason. | JPL to fix prior to GHQ |
| Sustainment | 6.5-2 Observe that maintenance has passed | Report needs to reflect unit levels vs. direct support | JPL to fix prior to GHQ |
| Sustainment | 6.5-3 Personnel attrition to CSSTSS | Report needs to reflect unit levels vs. evacuation | JPL to fix prior to GHQ |
| Sustainment | 6.6-1 Supply airlift | Unsuccessful. Fix in. Needs to be retested | NSC to test prior to GHQ |
| Sustainment | 6.6-4 CSS helicopter maintenance | Helicopter operations hours differ in CBS and CSSTSS | CASCOM and JPL to retest prior to GHQ. |

**Table 5.7**
**SIT Functional Test Coordination Matrix**

[17] There were 19 tests in the Sustainment portion of the CVVAMP - two of these tests were not applicable to the augmented Confederation.

## 5.2 GHQ 94 Testing

Testing consisted of technical testing in accordance with the ALSP Confederation Management Technical Test Plan and functional testing using the GHQ 94 Verification Test Plan, which was designed to test the capabilities of those functional areas which did not perform as expected during the confederation test in March. In lieu of systematic load testing data regarding key simulation items were gathered during the Mini-Ex on 17 May, 1994.

### 5.2.1 Test Objectives

The primary objectives of the GHQ 94 Test were to:

a. Verify that the participating actors meet the technical requirements for operating in an ALSP Confederation and that the ALSP Systems Software supports Confederation operations;
b. Verify and, to the extent possible, validate those functional capabilities which were either unsuccessful or only partially successful when test at the 1994 Confederation Test.

### 5.2.2 Technical Testing

The technical testing of the COM was performed on 2 - 3 May, 1994. The test plan which was executed was the same one conducted at the Confederation Test in March, 1994.

#### 5.2.2.1 Technical Test Areas

The Technical Test covered the following topics:

- joining and database verification between CBS and CSSTSS;
- recovery of the Confederation after CBS-CSSTSS messages are lost;
- joining and resigning from the Confederation;
- filter verification;
- object initialization;
- object refresh;
- time synchronization;
- ghosting of objects;
- confederation save and restore; and
- crash recovery;
- CBS-CSSTSS de-link.

#### 5.2.2.2 Technical Test Results

All actors in the Confederation successfully completed the Technical Test Plan. In addition, technical support personnel gained valuable experience in the procedures required to properly perform support operations for the COM. As a result of this experience the recovery process has been streamlined. Recoveries involving CSSTSS have been reduced from 95 minutes to 65 - 80 minutes.

### 5.2.3 Functional Testing

Standalone testing was performed on CBS and CSSTSS from 5 through 6 May, but verification testing of the confederation originally scheduled for that time period was not completed. Verification testing continued from 7 May through 13 May, and data continued to be gathered on the proper function of the relevant interfaces.

#### 5.2.3.1 Functional Test Areas

Functional testing involved 36 separate tests. Of these tests 13 had either failed or only partially succeeded at 1994 Confederation Test in March, and are listed in Tables 5.2 and 5.7. The remaining 23 tests covered areas for which it was felt that more detailed test results were required in order to increase our confidence in the previous test results.

#### 5.2.3.2 Functional Test Results

Prior to GHQ 94 STARTEX 32 of 36 tests were completed. Of the 32 completed tests, 31 were successful, and one was partially successful.

The partially successful test involved CSSTSS maintenance of Class VII items. CSSTSS properly receives the damaged items for repair, but if a CBS unit with items in maintenance splits or merges with another unit, CSSTSS can no longer find the unit which owns the equipment. A manual workaround was developed for this issue and successfully used during the exercise.

Table 5.8 shows the incomplete tests, the test results from the 1994 Confederation Test, and their potential impact on GHQ 94 should the interfaces have failed to work properly. Each test is discussed below.

| Test Not Completed | Results at 94 Confed Test | Possible Impact on GHQ 94 |
|---|---|---|
| VULCANs firing at aircraft | Did not fire | Negligible. |
| Convoy re-route around obstacle | Convoy stopped, did not re-route | Little impact. Convoy can be manually diverted or canceled |
| Convoy destruction due to impassable barrier | Convoy stopped, was not destroyed | Little impact. Convoy can be manually diverted or canceled |
| CSSTSS HELO maintenance | CBS continued to fly HELOs | Negligible. Standalone CBS does not play HELO maint. |

**Table 5.8 Incomplete Tests and Possible Impact on GHQ 94**

#### 5.2.3.2.1 Vulcans Firing at AWSIM Aircraft

This is part of the test designed to verify the proper operation of CBS SHORAD units vs. AWSIM aircraft. At the 1994 Confederation Test several SHORAD systems would not fire, including Chaparrals, Avengers, Mistrals and Vulcans. Testing was successfully completed on all SHORAD systems in the GHQ 94 database except Vulcans. For GHQ 94 this weapon system existed in very few units and there were no recorded firings during the exercise.

#### 5.2.3.2.2 Convoys Re-routing Around Obstacles

As described in the Sustainment ICD, convoys which are blocked by an obstacle in CBS are supposed to automatically choose an alternate route. During the 1994 Confederation Test convoys which encountered an obstacle stopped, but did not re-route. This test was started several times, but was not completed due to technical problems with the Confederation. This issue would have had little impact had it surfaced, because convoys can be manually diverted or canceled, but convoys appeared to re-route properly during the exercise.

#### 5.2.3.2.3 Convoy Destruction Due to Impassable Barriers

Convoys which cannot complete because of impassable barriers surrounding either the receiving unit or the convoy itself are supposed to 'self-destruct', with all supplies and trucks being removed from the simulation. Although the concept of a convoy or receiving unit being surrounded by impassable barriers is unrealistic, the test was designed to make sure such a situation would not cause any problems with the execution of the simulation. During the 1994 Confederation Test convoys surrounded by impassable barriers stopped, but were not destroyed. This test was started several times but was not completed due to technical problems with the Confederation. We were able to determine, however, that convoys in this situation caused no technical problems. This issue would have little impact on the Confederation, because convoys can be manually diverted or canceled.

#### 5.2.3.2.4 CSSTSS HELO Maintenance

One of the functionalities of CSSTSS is the processing of HELOs through scheduled maintenance. This functionality was tested unsuccessfully at the 1994 Confederation Test. CBS HELOs which accrued the appropriate number of flying hours were placed into maintenance by CSSTSS, but still retained the ability to be flown in CBS. This test was started several times but was not completed due to technical problems with the Confederation. The effect of this issue on GHQ 94 was negligible. Because CBS does not play HELO maintenance in standalone mode Army Aviation cells continued to fly HELOs as they normally would during a standalone CBS exercise, with no preventative maintenance being portrayed.

### 5.2.4 Load Testing

Only during the Mini-Ex on 17 May 1994 were we able to measure a load on the Confederation sufficient to draw conclusions on the expected load for GHQ 94. Data was gathered on fixed and rotary-wing air missions, active ADA and radar sites, convoys, and maneuver and combat service support units. Based upon the information gathered, and with the exception of unit splits and merges discussed in the following section, it was believed that the load on the COM during GHQ 94 will be well below those levels at which the COM was able to maintain a ratio of 1:1 during the 1994 Confederation Test.

# 6. COM SUPPORT OF GHQ 94

The COM was successfully used to provide support to GHQ 94 from 19 through 25 May, 1994. Data regarding COM availability, system load and model performed were gathered during the exercise. Lessons learned from this data can be used to better support future exercises such as Ulchi Focus Lens and Atlantic Resolve.

## 6.1 Confederation Availability

Figure 6-1 shows the availability of the confederation during GHQ 94. The amount of time which CONFED 94 was required to support training during the exercise totaled 4,040 minutes. Of that time, CONFED 94 was actually available for 2,858 minutes, or 71 percent of the required time.

| Date | Timeframe | Minutes | Downtime | | | | Total | % Uptime |
|---|---|---|---|---|---|---|---|---|
| | | Required | Comms | Hardware | Human | Software | Downtime | |
| 19 May | 0700-1920 | 740 | 224 | 94 | - | 69 | 387 | 48% |
| 20 May | 0700-1900 | 720 | 103 | - | 33 | - | 136 | 81% |
| 21 May | 0700-1900 | 720 | 57 | - | 73 | 50 | 180 | 75% |
| 22 May | ——— | 0 | Day off. No exercise support required. | | | | N/A | N/A |
| 23 May | 0700-1900 | 720 | 286 | - | - | - | 286 | 60% |
| 24 May | 0700-1900 | 720 | 149 | - | - | - | 149 | 79% |
| 25 May | 0700-1400 | 420 | - | - | - | 44 | 44 | 90% |
| **Totals** | | **4040** | **819** | **94** | **106** | **163** | **1182** | **71%** |

**Figure 6-1 Confederation Availability During GHQ 94**

While this percentage is a critically low number for simulation availability, the figure above shows that downtime related to confederation models or related software amounted to only 3 percent of required availability. Communications problems on the local and wide-area networks were the most significant contributors to confederation downtime, amounting to 20 percent out of the 29 percent of the time in which CONFED 94 was unavailable for exercise support. It was, in fact, communications problems between the NSC and Rock Island that led to the de-linking of CSSTSS from the confederation on May 23.

## 6.2 Confederation Load

Information concerning the load generated during GHQ 94 was collected at the NSC, Blue Flag / Joint Warfare Center (BF/JWFC) and Rock Island. This information includes the number of ground units, combat sets aircraft, etc., the resultant CPU and system memory utilization, and other key factors. This data has been forwarded to the Mitre Corporation for further analysis. The analysis of the load during GHQ 94 will give

potential users of CONFED 94 a more operationally oriented view of the performance of the confederation at the expected load of their exercises than can be determined from the data gathered at the Confederation Test in March 1994 at the WPC.

A comparison between certain key data elements from the Confederation Load Test at the WPC and GHQ 94 are presented in figure 6-2.

| Data Element | Typical Expected Load From '94 Confed Test | Average Load During GHQ 94 |
|---|---|---|
| Ground Units | 7,000 | 5,200 |
| Aircraft | 400 | 550 |
| Airbases | 50 | 95 |
| Naval Vessels | 475 | 250 |

**Figure 6-2 Key Data Elements For Confed Test vs. GHQ 94**

This small comparison shows that during GHQ 94 some of the key data elements exceeded the typical expected load tested during the Confederation Test. There were, however, no performance problems with hardware or software due to the load on the confederation.

There were problems encountered with CSSTSS's ability to process the number of splits and merges generated by CBS. This was not seen at the Confederation Test because of the inability to bring CSSTSS into the full Confederation until the last two days of testing. This issue is discussed in greater detail in the following section.

# 7. KEY ISSUES AND FINDINGS

## 7.1 CBS - CSSTSS Mirrored Databases

The mirrored database design of the sustainment interface is extremely sensitive to software, hardware, or communications disruptions. Such disruptions can result in a lack of a consistent representation of the battlefield across the Confederation. Unless gross discrepancies develop, however, this may have little impact on training. In those cases where the impact of inconsistent databases would have a significant impact on the exercise, the databases can be reconciled and recovered in approximately 65 minutes. In addition, because GHQ 94 was a 12-hour per day exercise the opportunity existed for daily checks of the databases and resynchronization as required.

## 7.2 Splits and Merges

Because of the way in which unit splits and merges are tracked and processed in CSSTSS, there is currently a practical limit of approximately 50 splits and/or merges per hour. This is because CSSTSS presently tracks all splits and merges, including those at the tactical level, which is irrelevant to that model. The long-term fix which has been proposed is for CBS to track ground units' tactical formations and for CSSTSS to end its logistical responsibilities at the UIC level, i.e. at the Battalion or Company level. In addition, CSSTSS will keep track of the ALSP ID of the parent unit of each new unit created, thereby creating an audit trail which can be followed in order to determine how and where to send returning or replacement personnel and equipment. For GHQ 94 the majority of necessary splits and merges were accomplished during off-hours. During exercise hours split and merge activities were monitored, and controller splits and merges were disabled at the workstations when the practical limit was approached.

## 7.3 Recovery

Should CSSTSS fail, or should CBS fail on an order involving a unit split or merge, the entire COM must be returned to the last checkpoint and all player activity subsequent to the checkpoint must be replayed. As a result, recovery time would range from 20 to 80 minutes, as compared with 20 minutes for other failures.

## 7.4 Systems and Communications Reliability

During the Operational Test, which was conducted from 9 through 11 May, the availability of the entire simulation environment was 69 percent. Software problems, as well as communications and hardware problems contributed to the unavailability. While some of the software problems were unrelated to the operation of the models, many new sustainment-related software problems arose as a result of subjecting the interface to a level of testing not previously experienced. During GHQ 94 the availability of the

confederation was 71 percent. Communications problems alone accounted for most of the confederation's downtime (20 percent). Improved stability of both the local and wide-area networks would have greatly enhanced CONFED 94's support of the exercise.

### 7.5 Naval Gunfire

Although the operation of the naval gunfire function was verified during the 94 Confederation Test and GHQ 94 pre-exercise testing, there appears to be a problem with the validity of the results of such operations. Attrition due to naval gunfire appears to be excessive, and further validity testing should be conducted. Because no naval gunfire was portrayed during GHQ 94, however, there was no impact on the conduct of the exercise.

# 8. RECOMMENDATIONS

## 8.1 Recommendations Concerning the Present Confederation

There was clearly a risk involved in the use of the seven-member COM in support of GHQ 94, and this risk continues to exist in its use in further exercises. The issues of mirrored databases, limited splits and merges, and system reliability could combine to create an unacceptably high amount of time in which the simulation environment is unavailable. Because GHQ 94 was executed on a 12-hour per day basis, there was a significant amount of time in which the COM could be taken off-line to investigate and solve any problems which occurred. In addition, careful monitoring of the simulations helped head off problems before they occurred. Finally, the alternative existed to de-link CSSTSS from the COM in the event that the limitations and issues related to its use became unacceptable. With these steps serving to alleviate associated risks, the seven-member Confederation of Models was recommended for accreditation for use in General Headquarters Exercise 94 by Dr. Robert LaRocque, Director of the National Simulation Center and accredited by LTG John Miller, Exercise Director for GHQ 94.

The issues of mirrored databases, limited splits and merges, and end of day processing, however, as discussed above, combine to create an unacceptably high amount of time in which the simulation environment would be unavailable during a 24-hour per day exercise. Because of these factors the seven member COM, consisting of the 1994 COM augmented by CSSTSS as it is currently configured, is not recommended for use in support of 24-hour CAXs.

## 8.2 Recommendations Concerning a Modified Confederation

A technical review of the Sustainment Interface Control Document (ICD) was held from 20 through 22 June, 1994 at Mitre Corporation in Mclean, VA. Relevant agencies such as the NSC, JPL, CASCOM, Mitre, and STRICOM were in attendance. The goals of this conference were to determine the necessary revisions to make to the Sustainment ICD in order to better support CAXs. It was determined that all of the necessary software changes can be made to CBS and CSSTSS to alleviate the problems of synchronized databases, limited splits and merges and end of day processing, as well as adding the capabilities of unit airlift, magic moves, magic supply and coordinated movement of CBS and CSSTSS units. Given presently available resources these modifications can be accomplished prior to the next ALSP Developers' Integration Test starting on November 23, 1994. If sufficient resources were provided, these modifications could be completed in time to support testing prior to Atlantic Resolve 94. However, this effort would have extensive impact on Confederation 95

activities and the 1995 testing schedule. Regardless of when such modifications are completed a full seven-member confederation test should be conducted before a recommendation is made regarding the accreditation of the seven member Confederation of Models in support of 24-hour CAXs.